SECTION B: REMARKS

I. INTRODUCTION

This Amendment is responsive to the Office Action dated February 6, 2003. Attached hereto, therefore, are a Request For An Extension of Time and the appropriate fee. If necessary, please charge any necessary fees to Deposit Account No. 01-1960.

Claims 1-27 are pending in this application. Claims 1-27 are subject to rejection. Claim 3 has been amended herewith, without prejudice.

II. CLAIM REJECTION UNDER 35 U.S.C. §112.

Claim 3 is rejected under 35 U.S.C. §112, second paragraph, for providing insufficient antecedent basis for "the fluid." Claim 3 has been amended in conformity with the comments stated in the Office Action.

III. CLAIM REJECTIONS UNDER 35 U.S.C. §102(e).

Claims 1-7, 9, 10, 14, 17 18, and 23-27 were rejected under 35 U.S.C. §102(e), as being anticipated by Kawaguchi et al., US Patent No. 6,112,806, ("Kawaguchi").

Initially in rejecting Claim 1, the Examiner cites Kawaguchi as reciting a heat exchanger comprising a surfactant solution and a fluid degradation device in combination with all the limitations further set forth in Claim 1. The rejection is respectfully traversed.

First, Kawaguchi does not teach or suggest "a fluid degradation device." The Examiner, as best understood, contends that irregularities on heat transfer surface 6 of heat transfer plate 2 (Fig. 1, col. 3 lines 13-21) are the same structure as the fluid degradation device 18 of the present invention. However, the fluid degradation device of the present invention is a separate structure than the heat exchanger itself (Fig. 2). On the contrary, the irregularities of Kawaguchi are an alteration of existing structure (i.e. heat transfer surface 6).

Second, and most importantly, what the irregularities of surface 6 are doing to the drag-reducing surfactant (hereinafter "DR surfactant") is completely different than in the present invention. In short, Kawaguchi uses heat from the heat transfer surface 6 to increase drag of the DR surfactant (col. 4 lines 38-49); and the fluid degradation device 18 instead induces high local shear stresses to increase heat transfer.

The mechanism by which Kawaguchi teaches to increase drag and heat transfer rate is explained in its specification in column 4, lines 38-49. It states that irregularities on the heat transfer surface having a special configuration increase the drag of the DR surfactant at the time the surfactant receives heat from the surface. Since the drag is increased, the rate of heat transfer increases until the DR surfactant moves into the mainstream and again retains its DR properties.

Conversely, the mechanism by which the present invention increases heat transfer rate, as defined by claim 1, is different. Firstly, the mechanism is not strictly dependent of heat flow into or out of the DR surfactant. Second, the fluid

degradation device is physically located upstream of the heat transfer surface that is different from irregularities *on* the heat transfer surface. This is important because it allows for a "recovery time" as set forth in Claim 1. Next, the present invention increases heat transfer by inducing high local shear stresses in the DR surfactant. Importantly, the presently claimed invention as defined by Claim 1, utilizes a "predetermined distance or time downstream" as a design parameter to allow for the recovery time. This is graphically illustrated in Fig. 3. As defined by Claim 1, the design objective is to achieve a heat exchanger efficiency that would be obtained if a DR surfactant is not used.

Stated slightly differently, the essence Kawaguchi's teaching is the recovery of heat transfer for DR surfactant solutions by the means of thermal degradation. That means that micellar structures are degraded by exposure to high temperature in the region close to the wall of a heat exchanger. Applicants' teaching is completely different. The present invention degrades the surfactant solution by mechanical stress. Kawaguchi's idea does not require a degradation device (to impose mechanical stress on the fluid), neither is he concerned with the "recovery time" of the degraded surfactant solution, as defined by Claim 1.

Additionally, Kawaguchi suggests to further increase heat transfer by affecting the flow by the conveniently shaped surface of the heat exchanger. There are many patented ideas, which intend to increase heat transfer of fluids in general, by changing the flow. This approach differs completely from the micellar degradation, which changes the fluid itself (not the flow). Note that degradation

(thermal or mechanical) applies only to surfactant solutions, not to fluids in general.

Applicant therefore respectfully asserts that independent Claim 1 is patentable for the reasons set forth above. Moreover, Applicants have prepared detailed remarks and arguments that distinguish the present invention from the prior art attached as Appendix A. Please consider these remarks, and importantly the attached appendix, as a complete and full response.

Referring to method Claim 2, the Examiner rejected the claimed invention for similar grounds as in Claim 1. Applicants respectfully traverses the rejection asserts that independent Claims 2 is patentable by containing the same limitations as in Claim 1, written as a method claim.

The Examiner's rejection of Claim 3 is respectfully traversed. Similar to the arguments presented in Claim 1, Applicants respectfully assert that "conditioning of the drag reducing properties relevant for degradation and recovery," is a novel claim limitation not found in the prior art. Please refer to the attached appendix for a detailed analysis.

Referring to Claims 4-7, 9, 10, 14, 17, 18, 23-27, please refer to the attached Appendix A, for a detailed technical comparison with respect to the cited art.

IV. CLAIM REJECTIONS UNDER 35 U.S.C. §103(a).

Claims 11, 12, 13, 15, 19, 20, 21, and 22 are rejected under 35 U.S.C. §103(a) as being unpatentable over the combined teachings of Kawaguchi and Brown, US Patent No. 4,702,312 (hereinafter "Brown").

Brown's ceramic rods are intended to increase heat transfer of high temperature gasses by the radiant heat transfer. Those rods are not intended to impose shear stress on the fluid. The idea of applying the mechanical shear stress to the fluid in order to break micellar structures can not be deduced from neither Brown's or Kawaguchi's teachings.

Applicants respectfully assert that Claim 11, 12, 13, 15, 19, 20, 21, and 22 are dependent claims, and are allowable for their dependency on independent claims, that themselves are allowable for the arguments presented, herein. Please refer to Appendix A for detailed arguments distinguishing Brown from the present invention.

V. CONCLUSION

Based on the above amendments and accompanying remarks, Applicant respectfully submits that all pending claims are in condition for allowance and earnestly solicit a notice thereof. Applicant further encourages the Examiner to telephone the under signed attorney if it appears that a telephone conference would facilitate allowance of the application.

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on ~~June 30, 2003~~ July 7

By: Nancy V. McElrath 7-7-03

Signature

~~June 30, 2003~~ July 7,

Respectfully submitted,

Timothy W. Fitzwilliam
Registration No. 46, 439
Myers, Dawes & Andras & Sherman LLP
19900 MacArthur Blvd., Suite 1150
Irvine, CA 92612
(949) 223-9600

Appendix A

Background for the response to Office Action : Summary analysis of the applied-for patent and the patents cited by the Examiner in his Office Action

Patent application 09/786,140 for "Methods to control heat transfer in fluids containing drag-reducing additives" by Gasljevic and Matthys

In this application, the inventors describe means of increasing heat transfer when the heat transfer fluid in heat exchangers is a drag-reducing liquid solution of surfactant. To achieve this goal, the inventors propose a combination of a customized fluid showing specific needed characteristics for degradation and recovery together with means of degradation of the micellar structure of the fluid through the application of a high enough mechanical shear stress that the micelles are temporarily broken. The proposed means of heat transfer control work with both heating and cooling systems. One of the primary concept of the invention is that the fluid itself *is temporarily modified by the application of a* mechanical *stress, in contrast to previous methods of heat transfer control used for Newtonian fluids that involved modifications to the* flow *using flow disturbances such as turbulators or corrugated surfaces. The latter flow-only (not fluid) modifications have indeed been shown not to be economically feasible for drag-reducing fluids because of the large pressure drops required to increase the heat transfer back to Newtonian fluid levels. Furthermore, the invention specifies that the recovery time of the fluid must be tailored to the residence time in the heat exchanger as well as to the location of application of the mechanical stress used for degradation. For example, it is disclosed that a discrete degradation device located at the entrance of the heat exchanger may be optimal in some cases. Also, a fluid showing temperature independence of the drag reduction level and recovery times over a wide range of temperature as well as possessing a recovery dead time is disclosed as an optimal fluid for these applications. The patent application also covers the optimization of the degradation devices to provide minimal adverse pressure drop. It is important to note that the application covers both fluids of specific properties, mechanical devices for micellar structure modification, and the well-defined and optimized relationship between the fluid and the degradation devices.*

U.S. Patent 6,112,806 by Kawaguchi et al.

The essence of this patent is that the Inventors rely on the notion of increasing the fluid temperature inside the heat exchanger and near the heat exchange surface to a high level such that the Drag Reduction ability of the fluid is decreased in that region (e.g. col. 3 lines 65-67 and col. 4 lines 1-3). This effect is based on thermodynamic equilibrium issues and is a function of temperature only. It is not related at all to mechanical stresses. The Inventors

do mention an irregular heat exchange surface but this is only done in the context of increasing locally the heat exchange as one would do for Newtonian fluids (col. 4 lines 3-14), and is not related to non-Newtonian (e.g. drag-reducing) effects. In other words, these irregularities affect the flow, not the fluid. There is no mention whatsoever in this patent of breaking down the micellar structure of the fluid using mechanical stresses.

The patent as described covers only the case of heating systems where the drag-reducing fluid can be brought to a high enough temperature that the micellar structure of the fluid can be affected. Furthermore, the heat exchanger features proposed in this patent only apply to the heat exchanger where the drag-reducing solution is heated, not on the other side of the thermal system where the solution is cooled, essentially making the proposed approach unworkable in general practice. The heat exchanger proposed in this patent would also not work at all for cooling systems where the drag-reducing solution is kept at low temperatures well below the critical temperature A in Fig. 2. Finally, it is important to note that Kawaguchi's patent is limited to a heat exchanger design and does not disclose nor address the optimization or customization of a fluid to match the heat exchanger characteristics.

It should also be mentioned that the basic concept of increasing heat transfer for drag-reducing solutions using localized high temperatures in a heat exchanger –the very basis of Kawaguchi's patent- was studied in our laboratory and proposed in publications by Gasljevic and Matthys [see for example "A feasibility study of the use of drag-reducing additives to reduce pumping power in hydronic thermal distribution systems" by Gasljevic and Matthys, FED- Vol. 132, pp. 62, ASME, December 1991] well before Kawaguchi et al. filed their application.

U.S. Patent 4,702, 312 by Brown

This patent covers the use of thin rod packing for heat exchangers in order to increase heat transfer for high-temperature gases. In this patent the Inventor describes how using thin rods in a tube will increase the heat exchange. The effect described is based on taking advantage of radiative effects between the thin rods and the primary heat exchange surface (e.g. col. 4, lines 15-23). Obviously, this applies only to gases since radiation effects would be minor in liquids because of absorptivity effects, and is also only relevant at the high temperatures where radiative effects become significant. The inventor indeed mentions a temperature of at least 1,000 F (col. 4 line 40-45). Clearly, such an approach would not be workable at all for liquids at low temperature such as those encountered in drag reduction applications. Obviously, since this invention is limited primarly to high-temperature gases, there is no mention of any effect of such rod packing on non-Newtonian fluid properties such as micellar structure. This patent is not addressing at all any drag-reducing surfactant fluids nor micellar effects.

Analysis of the Rejection of claims by the Examiner

1. Claim rejections – 35 USC $102

Claim 1: The Examiner rejected Claim 1 as being anticipated by Kawaguchi et al. as discussed in Office Action page 3. In his analysis, the Examiner states that Kawaguchi proposes a solution characterized by an optimized recovery time, micellar structure rebuilding, degradation by high local shear stresses for a predetermined distance downstream, recovery etc. We respectfully submit that Kawaguchi et al. did not address any of these issues in their patent -nor even mention any of this language which is in fact that found in our own patent application and not in Kawaguchi's. Indeed, their approach to fluid modification relies entirely on bringing the temperature of the fluid locally near the heat exchange surface to a temperature high enough that the "large-scale structures" they describe are supposedly eliminated (see col. 3 lines 64-67 and col. 4 lines 1-3). This is a presumably referring to -but not explicitly mentioning- a well-known thermodynamic effect which is causing micellar breakdown at high temperature. There is no mention of degradation by mechanical stress at all in Kawaguchi's patent nor in fact is there a need to be since their proposed heat transfer design does not take advantage at all of mechanical degradation. The irregular surface 6 listed in this patent is clearly not intended to affect the very nature fluid at all, only the flow of the fluid near the surface (col. 4 lines 3-14). Kawaguchi indeed clearly states that this irregular surface results in fluid acceleration at some locations thereby decreasing the thermal boundary layer thickness and a shift in separation point. Despite the questionable soundness of this description, it can only be interpreted as saying that the flow field is changed near the irregular surface because of the presence of these irregularities (col. 4 lines 3-14). This effect is the very same effect used by the many well-known flow-modification devices used for heat transfer enhancement of Newtonian fluids, which were in fact shown not to be sufficiently effective for drag-reducing fluids. This effect is entirely distinct from the notion of using devices to modify the fluid itself using suitable shear stresses. It is also not likely to result in full heat transfer recovery given that only thin thermal boundary layer will be affected by the local high temperatures.

Addressing some specific points raised by the Examiner about Claim 1 :

- the surfactant solution 7 was not characterized by an "optimized recovery time as defined by ability of the surfactant solution 7 to rebuild molecular or micellar-structure after disruption of the molecular or micellar-structure (col. 4 lines 25-35)" in Kawaguchi's patent. There is in fact no mention of recovery time in Kawaguchi's patent. The "reestablishment" of drag reduction (col.4 line 31) is referring to a lowering of temperature in the rest of the system which would result in a decrease in drag downstream. This effect is related to temperature-caused thermodynamic effects and not to dynamic micellar recovery following micellar breakdown by shear

stresses. The two effects are fundamentally different. Furthermore, the reliance on a lowering of temperature as described in Kawaguchi's patent would not provide suitable control over the distance at which full drag reduction will be covered, thereby possibly negating much of the claimed advantages of the technique. (In contrast, in our claims the fluid is tailored to have a recovery time matching the residence time in the heat exchanger.)

- There is no mention of there being a "fluid degradation device 5 to create temporaray fluid degradation....", as described by the Examiner in Kawaguchi's patent. The irregularities he mentions (col. 3 lines 13-17) pertain strictly to the heat transfer surface which is intended to accelerate the fluid and shift flow separation (col. 4 lines 3-14), i.e. disturb the flow. This is a well-known flow modification approach that is not intended at all to degrade the fluid itself.
- There is no mention of "high local shear stresses so that heat transfer is increased in the heat exchanger for a predetermined distance or time..." in Kawaguchi's patent. Col. 3 lines 64-67 and col. 4 lines 1-8 refer to increasing the temperature of the drag-reducing fluid past the critical value A. Col. 4 lines 25-35 etc refer to the reestablishment of drag reduction after the temperature is lowered by mixing and not to a recovery time after a mechanical shear stress.

On the contrary, our Claim 1 specifically identifies and lists a surfactant solution characterized by an optimized recovery time after disruption, a fluid degradation device to break micellar structure by high local shear stresses to increase heat transfer for a predetermined time and a subsequent recovery to full heat transfer level.

We respectfully submit that Kawaguchi's patent and our application address and make use of completely separate and unrelated effects and principles, and we respectfully request that the rejection of Claim 1 be reconsidered and that Claim 1 be approved by the Examiner.

Claim2: Referring to the Examiner's rejection of Claim 2, we respectfully submit that –as stated in our discussion above- there is no "predetermined recovery time" mentioned nor implied in Kawaguchi's patent, there being no need for this concept given his approach to removal of "large-scale structures" (col. 2 line 20) using localized high temperatures (col. 3 lines 44-46). Note also that there is in fact no specific mention of intentional micellar structure modification by mechanical degradation or high shear stresses at all in Kawaguchi's patent nor should there be given his use of a completely different technique to achieve a heat transfer increase. The reestablishment of drag reduction downstream of the heat exchanger is simply due to a lowering of temperature (col. 4 lines 26-32). The facts and rationale are the same as those expanded on in the summary analysis of patents and in the rebuttal of Claim 1 rejection above.

In our Claim 2, on the other hand, we specifically propose a surfactant solution characterized by a predetermined recovery time, degradation by local stresses, and recovery after a predetermined distance.

Accordingly, we respectfully request that the rejection of Claim 2 be reconsidered and that Claim 2 be approved by the Examiner.

Claim 3: As discussed above, there is no mention of- nor implied existence of a degrading device creating "a minimum pressure drop" in Kawaguchi's patent. There is no reference to "conditioning of the drag-reducing fluid properties for degradation and recovery" since Kawaguchi makes no use of the mechanical degradation concept in his patent (see discussions above).

In our claim, on the other hand, we list specifically a degrading device providing minimum pressure drop, creating degradation, and the conditioning of the fluid in a way suitable to the use of the degradation device.

Accordingly, we respectfully request that the rejection of Claim 3 be reconsidered and that Claim 3 be approved by the Examiner.

Claim 4: The Examiner mentions a "surfactant additive capable of withstanding stresses in all pipes and fittings of a circulation system and providing asymptotic drag reduction in straight pipes..." per our Claim's language. We respectfully submit that there is no mention whatsoever of stresses in pipes and fittings nor of asymptotic reduction in Kawaguchi's patent. In his patent, Kawaguchi's suggests that temperature be kept at a low temperature in the rest of the system (col. 3 lines 50-59) to reduce the drag there. Kawaguchi's patent does not address resistance to mechanical stresses in the main lines of the system since this is a concept entirely linked to mechanical degradation, which he does not use in his patent. In fact, in practice it is entirely possible that the temperature be low enough in the main pipes to avoid the thermal effects used by Kawaguchi in his heat exchanger design and yet have the fluid be degraded in the main pipes because of high stresses in fittings, which would make his approach unworkable at the system level. There is also no discussion of an intentional rapid recovery immediately after the fluid exits from the heat exchanger. Furthermore, in Kawaguchi's patent, the disclosures are all about the heat exchanger, not about the fluids. Indeed he uses well-known standard fluids in his example and does not suggest that these be modified. Other points raised in the discussion of the claims above apply as well.

In our claim, on the other hand, we list specifically the fact that the fluid has to be modified in such a way that it will withstand the stresses in all pipes and fittings, that there has to be asymptotic drag reduction in the straight pipes, that there is to be a degradation device, and that the fluid has to remain substantially

degraded in the heat exchanger yet has to recover quickly after exit from the heat exchanger. This claim is about the fluid, unlike all of Kawaguchi's disclosures.

Accordingly, we respectfully request that the rejection of Claim 4 be reconsidered and that Claim 4 be approved by the Examiner.

Claim 5: We respectfully submit that there is no mention nor reference nor implication of any "dead time and a fast recovery" in Kawaguchi's patent. A "dead time" is an effect coined by ourselves in our laboratory describing a peculiar dynamic effect during which the recovery of the fluid after mechanical degradation is delayed for a specific period of time. This effect is not relevant to the removal of large-scale structures by high temperature as proposed by Kawaguchi. Here again we disclose a specific fluid, whereas Kawaguchi discloses a heat exchanger.

Accordingly, we respectfully request that the rejection of Claim 5 be reconsidered and that Claim 5 be approved by the Examiner.

Claim 6: There is no mention whatsoever of having a drag-reducing surfactant solution showing substantial independence of drag-reducing ability etc as a function of temperature in Kawaguchi's patent. In fact, in col. 1 lines 55-60, Kawaguchi discusses a fluid showing a "sharp response to changes in temperature", the very opposite of the independence of properties with temperature as proposed in our Claim 6. Kawaguchi disclosures are limited to a heat exchanger design, and are not about an optimized fluid.

Conversely, our Claim 6 discloses a fluid with properties independent of temperature.

Accordingly, we respectfully request that the rejection of Claim 6 be reconsidered and that Claim 6 be approved by the Examiner.

Claim 7: There is no mention whatsoever of having "a mixture of surfactant with opposing effects of temperature... recovery times" in Kawaguchi's patent. In fact, in col. 3 lines 2-6 and col. 3 lines 25-50, Kawaguchi proposes to use solutions of a single surfactant with a given set temperature response. He does not disclose anything about optimized specific fluid characteristics.

Conversely, our Claim 7 discloses a mixture of surfactants with opposing effects of temperature on properties in order to achieve a suitable temperature independence overall.

Accordingly, we respectfully request that the rejection of Claim 7 be reconsidered and that Claim 7 be approved by the Examiner.

Claim 9: There is no mention of having "a degrading device" in Kawaguchi's patent. Again, his heat transfer design relies on loss of drag reduction at high temperature (see above).

Conversely, our Claim 9 discloses a fluid path including a degradation device using shear stress.

Accordingly, we respectfully request that the rejection of Claim 9 be reconsidered and that Claim 9 be approved by the Examiner.

Claim 10: There is no mention "a degrading device" in Kawaguchi's patent, let alone a dedicated one used exclusively for degradation of a fluid.. See above.

Conversely, our claim 10 discloses a device used exclusively for degradation.

Accordingly, we respectfully request that the rejection of Claim 10 be reconsidered and that Claim 10 be approved by the Examiner.

Claim 14: Kawaguchi does not address degrading devices in his patent. His irregular surface 6 which is used for flow modification in the high temperature region and is not a degradation device, is the actual heat exchange surface itself and represents essentially the functional part of the heat exchanger device in its entirety.

Conversely, our Claim 14 discloses a dedicated device, separate from the main heat exchange surface, which can be positioned near the entrance of the heat exchanger.

Accordingly, we respectfully request that the rejection of Claim 14 be reconsidered and that Claim 14 be approved by the Examiner.

Claim 17: Kawaguchi does not address conventional hydraulic components located upstream of the heat exchanger in his patent. His patent addresses only the design of the heat exchange surface inside the heat exchanger.

Conversely, our Claim 17 discloses the use of a separate hydraulic component located upstream in close proximity of the heat exchanger.

Accordingly, we respectfully request that the rejection of Claim 17 be reconsidered and that Claim 17 be approved by the Examiner.

Claim 18: There is no mention of nor reference to mechanical degradation devices in Kawaguchi's patent, nor of fluid conditioning, nor of initial and subsequent additional mechanical disturbances.

Conversely, our Claim 18 discloses the use of specific mechanical degrading devices used at additional locations in the heat exchanger to degrade the fluid initially with minimal pressure drop, and then to prevent fluid recovery using additional disturbances.

Accordingly, we respectfully request that the rejection of Claim 18 be reconsidered and that Claim 18 be approved by the Examiner.

Claim 23: There is no mention of nor reference to using a secondary pump in Kawaguchi's patent, and modification to the flow rate are not addressed.

Conversely, our Claim 23 discloses the use of a separate secondary pump located in a circuit parallel to the heat exchanger in order to increase the flow rate.

Accordingly, we respectfully request that the rejection of Claim 23 be reconsidered and that Claim 23 be approved by the Examiner.

Claim 24: There is no mention of nor reference to having a fluid showing properties independent of temperature in Kawaguchi's patent. As mentioned above, his approach does in fact rely on large effects of the temperature on the drag-reducing ability of the fluid. Kawaguchi's patent is also limited to the heat exchanger design.

Conversely, our Claim 24 discloses the use of an optimized fluid showing properties independent of the temperature.

Accordingly, we respectfully request that the rejection of Claim 24 be reconsidered and that Claim 24 be approved by the Examiner.

Claim 25: There is no mention of nor reference to mechanical degradation devices in Kawaguchi's patent, as discussed above. There is also no reference to pressure drop measurements.

Conversely, our Claim 25 discloses the use of the degradation device to characterize the degradability of a fluid using a measurement of the pressure drop over the degradation device.

Accordingly, we respectfully request that the rejection of Claim 25 be reconsidered and that Claim 25 be approved by the Examiner.

Claim 26: There is no mention of nor reference to mechanical degradation or recovery time in Kawaguchi's patent, as discussed above.

Conversely, our Claim 26 discloses the use of the a fluid exhibiting a predetermined recovery time, this recovery time being independent of the fluid velocity.

Accordingly, we respectfully request that the rejection of Claim 26 be reconsidered and that Claim 26 be approved by the Examiner.

Claim 27: There is no mention of nor reference to modifying the nominal flow rate of a thermal exchange system in Kawaguchi's patent.

Conversely, our Claim 27 discloses the use of a method that will result in increased overall heat transfer over the nominal design specifications for the solvent by using a drag-reducing fluid at higher than nominal flow rate, and achieving higher than nominal heat transfer through the use of a degrading device to recover full Newtonian heat transfer in the heat exchanger.

Accordingly, we respectfully request that the rejection of Claim 27 be reconsidered and that Claim 27 be approved by the Examiner.

3. Claim rejections – 35 USC $103

A brief analysis of the patents by Kawaguchi and Brown was provided in the background section. As discussed above, it is clear that Kawaguchi's patent uses the principle of lowered drag reduction at high temperature, and –unlike our application- not that of mechanical degradation of micellar structure using local high shear stresses. Brown's patent on the other hand discloses the use of a rod packing device to increase heat transfer in a high temperature gas system using the principle of increased radiative heat transfer, unlike our application which is focused on mechanical degradation of lower temperature drag-reducing liquids.

It is our understanding that the Examiner is rejecting Claims 11, 12, 13, 15, 19, 20, 21, and 22 based on the notion that it would be possible to combine Kawaguchi's and Brown teachings to achieve the same results as our application. We also note that in his analysis the Examiner now states in this section that Kawaguchi did not disclose degradation devices, as we indeed submitted in our previous discussion.

We respectfully submit that since Kawaguchi's invention is not at all related to ours in its principle or embodiment, and since Brown's invention is used for a different purpose in completely different application, the combination of the two would not preempt our claims since the resulting combination would be completely unrelated to ours and also not able to achieve the same desirable outcome as our inventions. In addition, the combination of these two technologies could not have been thought of as an obvious possibility by a person having ordinary skill in the art since their purposes are completely different and aimed at different situations and different fluids. In fact, the fact that they are intended for completely different purposes would make an ordinary practitioner of Heat Transfer discount the very notion. For instance, a user of Kawaguchi's heat exchanger design would not consider using Brown's thin rod packing technique –even if it were to work- since Kawaguchi's design is entirely dependent on temperature effects on a drag-reducing fluid and does not include mechanical degradation devices such as a thin rod pack could possibly be thought of. Similarly, a person of ordinary skill in Brown's field and a user of Brown's invention would not have been able to draw the conclusion that such a device intended for high-temperature gas flows could have possibly been useful for low-temperature drag-reducing liquids since the very nature of the mechanical degradation process for such fluids would be an alien concept for the person working with high-temperature gases. In fact, on the contrary, one would recognize that Brown's device would not work with our fluids for the reasons stated in his patent, because of the need for high temperature and a radiation-transparent medium.
For somebody to suggest that a device only superficially related to Brown's invention might possibly be useful under an entirely new set of circumstances for a completely different type of fluids and for completely different fundamental reasons, would require extensive knowledge of drag-reducing surfactant fluids, of

their degradability characteristics, of the effect of mechanical degradation on heat transfer and so on, a very specialized type of knowledge and a unique idea and approach that we are precisely disclosing in our inventions.

Finally, it is important to recognize that the essence of our inventions has to do with the judicious combination of a suitable fluid of customized characteristics with a specific degradation device of suitable mechanical configuration and degradation characteristics. This important combination of effects would still be absent altogether from a hypothetical combination of Kawaguchi and Brown teachings since the concept of a drag-reducing fluid exhibiting predetermined and necessary characteristics is not present in either one of these patents.

We respectfully submit therefore that a person of ordinary skill in the art would not have thought of combining the inventions by Brown and Kawaguchi and that this unlikely combination would not have achieved the same objectives as our inventions.

Claim 11: There is no mention of nor reference to degradation devices in Kawaguchi's patent. Brown's invention's purpose is not to impose a shear stress uniformly across the cross-section of the fluid path. It is to increase radiative heat transfer between the rods and the tube walls (col. 4 lines 17-40). It also requires high temperatures (over 1000F – col. 4 lines 40-45). It is not aimed at modifying the nature of the fluid flowing over the pack. Since Brown's device is not intended to generate a shear stress nor to degrade a fluid, and Kawaguchi does not discuss mechanical degradation of the fluid, it would not be obvious for somebody of ordinary skill in the art to think of modifying Kawaguchi's invention by providing a degradation device based on Brown's invention.

Conversely, our Claim 11 discloses the use of a degrading device for drag-reducing fluids that specifically imposes a uniform shear stress over the cross-section of a heat exchange path to modify the micellar structure of a drag-reducing fluid. This is to maximize the efficiency of the mechanical degradation process (i.e. lower its economic cost) and of the resulting heat transfer increase.

Accordingly, we respectfully request that the rejection of Claim 11 be reconsidered and that Claim 11 be approved by the Examiner.

Claim 12: There is no mention of nor reference to supercritical shear stresses in Kawaguchi's patent since a supercritical shear stress is a concept only relevant to mechanical degradation which Kawaguchi does not address nor use. Brown's invention's purpose is not to impose a degrading shear stress on the fluid either. Therefore it would not be obvious for somebody of ordinary skill in the art to think

of modifying Kawaguchi's invention by providing a degradation device based on Brown's invention.

Conversely, our Claim 12 discloses the use of a degrading device for drag-reducing fluids that specifically imposes at least a supercritical shear stress to modify the micellar structure of a drag-reducing fluid.
Accordingly, we respectfully request that the rejection of Claim 12 be reconsidered and that Claim 12 be approved by the Examiner.

Claim 13: There is no mention nor reference to degradation nor supercritical shear stresses in Kawaguchi's patent. Brown's invention's purpose is clearly not to impose a degrading shear stress on the fluid either. Therefore it would not be obvious for somebody of ordinary skill in the art to think of modifying Kawaguchi's invention by providing a degradation device based on Brown's invention in order to generate a shear stress that is larger than but not significantly higher than the supercritical shear stress.

Conversely, our Claim 13 discloses the use of a degrading device for drag-reducing fluids that specifically imposes at least a supercritical shear stress to modify the micellar structure of a drag-reducing fluid, but on the other hand does not generate a shear stress significantly higher than said supercritical stess. This invention is to minimize the adverse pressure drop over the degrading device and therefore the economic cost of the heat transfer control technology.

Accordingly, we respectfully request that the rejection of Claim 13 be reconsidered and that Claim 13 be approved by the Examiner.

Claim 15: There is no mention of nor reference to mechanical degradation devices in Kawaguchi's patent. Brown's invention's is a thin rod packing of high absorptance and emittance and suitable high-temperature properties (col. 4 line 29-34), and not at all a wire mesh as described in our application. Therefore it would not be obvious for somebody of ordinary skill in the art to think of modifying Kawaguchi's invention by providing a degrading device of a wire mesh type, based on the knowledge of Brown's invention.

Conversely, our Claim 15 discloses the use of a specific mechanical degrading device for drag-reducing fluids that is based on a wire mesh concept to modify the micellar structure of a drag-reducing fluid.

Accordingly, we respectfully request that the rejection of Claim 15 be reconsidered and that Claim 15 be approved by the Examiner.

Claim 16: There is no mention of filters nor of mechanical degradation devices in Kawaguchi's patent. Brown's invention's is a thin rod packing which serves no filtering purpose. Therefore it would not be obvious for somebody of ordinary skill in the art to think of modifying Kawaguchi's invention by providing a degrading device of a wire mesh type that would also function as a filter, based on knowledge of Brown's invention.

Conversely, our Claim 16 discloses the use of a specific mechanical degrading device for drag-reducing fluids that is based on a wire mesh that can also function as a filter.

Accordingly, we respectfully request that the rejection of Claim 16 be reconsidered and that Claim 16 be approved by the Examiner.

Claim 19: There is no mention nor reference to mechanical degradation devices in Kawaguchi's patent. Brown's invention's is a thin rod packing which serves no mechanical degradation purpose. Therefore it would not be obvious for somebody of ordinary skill in the art to think of modifying Kawaguchi's invention by providing additional mechanical degrading devices at various locations in the heat exchanger, based on knowledge of Brown's invention.

Conversely, our Claim 19 discloses the use of specific mechanical degrading devices used at additional locations in the heat exchanger to prevent fluid recovery and especially necessitating a smaller pressure drop than the one located at the entrance to the heat exchanger.

Accordingly, we respectfully request that the rejection of Claim 19 be reconsidered and that Claim 19 be approved by the Examiner.

Claims 21 and 22: There is no mention nor reference to mechanical degradation devices in Kawaguchi's patent. Brown's invention's is a discrete thin rod packing device which serves no mechanical degradation purpose. Therefore it would not be obvious for somebody of ordinary skill in the art to think of modifying Kawaguchi's invention by taking advantage of the shear stress at the wall to degrade the fluid at the entrance of the heat exchange and inside as well to keep it from recovering.

Conversely, our Claims 21 and 22 disclose the use of shear stress generated by the pipe wall in the heat exchanger to degrade the fluid and to prevent its recovery throughout the heat exchanger.

Accordingly, we respectfully request that the rejection of Claims 21 and 22 be reconsidered and that Claims 21 and 22 be approved by the Examiner.

Claim 8. This Claim discloses the use of a very specific combination of two distinct types of surfactant as heat transport fluid in thermal distribution systems involving drag-reducing fluids. The purpose of this unique and otherwise unlikely combination is to achieve a very specific type of fluid properties, namely drag reduction properties that show substantial temperature independence. The choice of this type of fluid is an important aspect of our inventions in that it will enable us to generate substantial heat transfer improvements in all the heat exchangers in the system and not only one (as in Kawaguchi's patent for instance). This would otherwise not be possible with a fluid showing large variations of drag reduction properties with temperature since the fluid recovery would be substantially different in duration at different locations in the thermal system. As mentioned above, an important aspect of our inventions is the deliberate matching of fluid properties and mechanical degradation device characteristics to achieve meaningful heat transfer improvement in the heat exchanger.

Accordingly, we respectfully request that the rejection of Claim 8 be reconsidered and that Claim 8 be approved by the Examiner.